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In addition to research, we have begun to actively promote the most promising technologies through our NCAP program. For example, in 2015, we plan to add automatic emergency braking as a recommended technology to encourage consumers to seek this critical automation technology and give automakers an incentive to include it in large numbers of in their vehicles.

At the same time, NHTSA and other DOT agencies, in conjunction with the auto industry, have been conducting in-depth research and demonstration of V2V communications technology. In fact, NHTSA issued an Advance Notice of Proposed Rulemaking in August 2014, indicating its intention to require V2V capability in new vehicles in future years. NHTSA believes that V2V (and vehicle-to-infrastructure, vehicle-to-pedestrian, and related technologies) are critical to realization of the full potential of single-vehicle safety technologies, and that the future is one of connected automation.

Two additional technologies also offer great safety potential and are among our priorities. We continue to work with industry on research concerning the Driver Alcohol Detection System for Safety (DADSS), which could prevent a vehicle from being driven by a drunk driver and could help prevent or mitigate these crashes that kill over 10,000 people annually. Seat belt interlock technology could prevent a vehicle from being driven in a normal fashion (e.g., above a certain speed) when the driver and passengers are not safely buckled and could prevent some of the thousands of unbelted fatalities that continue to occur each year.

Yet even as we look to the future of advanced crash avoidance technologies, we continue to look for new and innovative ways to improve safety when crashes occur. These efforts include research and regulatory activities that seek to afford injury protection to occupants through new and improved vehicle design, materials and structures; as well as through passive and active restraints such as seat belts, air bags, child seats and motorcycle helmets. Research activities in crashworthiness include a frontal oblique test procedure consistent with real world crashes, an advanced 50<sup>th</sup> percentile male crash test dummy, a new brain injury criterion that measures head rotation of the test dummy to predict the risk of brain injury and advanced automatic collision notification for Emergency Medical Services when crashes occur.

Crashworthiness activities are also responsive to anticipated changes in the vehicle fleet such as enhancing fleet system modeling efforts for evaluating the safety of future lightweight vehicle designs and developing test procedures for evaluating the safety of lithium ion battery systems used by hybrid and electric vehicles.

This plan contains the priority projects and activities within those projects, organized by program areas. As stated above, however, it is not a complete list of all projects in NHTSA's Office of Vehicle Safety and does not describe efforts in other NHTSA offices. Projects that

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warrant priority consideration generally fall into the following four categories: (1) large safety benefits, (2) vulnerable populations, (3) high-occupancy vehicles and (4) other considerations.

Our belief that some of these projects will have large safety benefits is based upon factors such as the size of the target population, the effectiveness of countermeasures to save lives and prevent injuries, the availability and practicability of these countermeasures, and the potential that countermeasures could be developed in the future that could be reasonably effective for a large target population. Projects also may be considered a priority because they affect children, older people, visually impaired persons or other populations that are considered vulnerable. Projects may be considered a priority because they affect high-occupancy vehicles (e.g., buses and motorcoaches). Finally, some priority projects and activities either reduce the impact of motor vehicles on energy and climate change or address other specific items (e.g., statutory mandates not fitting in any other category).

Milestones describing anticipated agency actions and expected dates are provided for almost all activities. Note that dates are given in calendar years, not fiscal years. The next action for projects that are in the research stage is often an "agency decision." In general, an agency decision is a determination about whether the project or activity is ready and worthy to move from the research stage into the rulemaking or consumer information stage, whether the project or activity requires further research, or whether the potential benefit does not warrant further expenditure of resources. This agency decision is based on many factors, including estimates of the target population, readiness of technology, potential effectiveness of countermeasures, development of a test protocol, what information remains unknown, other agency activities and available resources.

Projects in the plan are organized within the following program areas:

*Data Improvement*  
*Crash Avoidance and Automation*  
*Electronics Reliability and Security*  
*Pedestrian Safety*  
*Crashworthiness and Post-Crash Safety*  
*Fuel Efficiency and Alternative Fuels*  
*Consumer Safety Information and Outreach*

We hope the plan provides useful information to all who are interested in NHTSA's activities.

Daniel C. Smith  
Senior Associate Administrator for  
Vehicle Safety  
June 2015

**Appendix XV. USDOT, *Connected Vehicle Pilot Deployment Program.***

# Intelligent Transportation Systems - Connected Vehicle Pilot Program

## Ready for Deployment

On September 14th, 2015, the USDOT announced the selection of three connected vehicle deployment sites in the Connected Vehicle Pilot Deployment Program. The three sites collectively envision a broad spectrum of applications enabled by connected vehicle technologies driven by site-specific needs. The three pilot sites include using connected vehicle technologies to improve safe and efficient truck movement along I-80 in southern Wyoming, exploiting vehicle-to-vehicle (V2V) and intersection communications to improve vehicle flow and pedestrian safety in high-priority corridors in New York City, and deploying multiple safety and mobility applications on and in proximity to reversible freeway lanes in Tampa, Florida. This initial wave of pilot deployments begins with an initial concept development phase lasting 12 months. Phase 1 focuses on the systematic refinement of the core concept of operations, system requirements and a comprehensive deployment plan. Robust and comprehensive deployment planning will facilitate a rapid progression to physical, real-world deployment of these concepts in Phases 2 and 3 of the program. The three pilot sites will work cooperatively amongst themselves, the USDOT, and additional stakeholders and team members as appropriate in order to maximize program productivity. This cooperative model is expected to benefit both this current effort as well as a second wave of pilot deployment sites to be identified later in the program.

Please explore this site for a more detailed description of CV Pilots objectives, research progress, and outcomes. We will continue to upload relevant program information for public consumption as it becomes available.

CV Pilots Portal

**Appendix XVI. Press Release, GM, Cadillac to Introduce Advanced 'Intelligent and Connected' Vehicle Technologies on Select 2017 Models (Sept. 7, 2014).**

# Cadillac to Introduce Advanced 'Intelligent and Connected' Vehicle Technologies on Select 2017 Models

## Super Cruise and V2V technologies slated for production in about two years

2014-09-07



**DETROIT** – Cadillac will begin offering advanced “intelligent and connected” vehicle technologies on certain 2017 model year vehicles, General Motors CEO Mary Barra said Sunday during her keynote address at the Intelligent Transport System (ITS) World Congress in Detroit.

In about two years, an all-new 2017 Cadillac vehicle will offer customers an advanced driver assist technology called Super Cruise and in the same timeframe the 2017 Cadillac CTS will be enabled with vehicle-to-vehicle (V2V) communication technology.

“A tide of innovation has invigorated the global auto industry, and we are taking these giant leaps forward to remain a leader of new technology,” Barra said. “We are not doing this for the sake of the technology itself. We’re doing it because it’s what customers around the world want. Through technology and innovation, we will make driving safer.”

Super Cruise, the working name for GM’s automated driving technology, will offer customers a new type of driving experience that includes hands-off lane following, braking and speed control in certain highway driving conditions. The system is designed to increase the comfort of an attentive driver on freeways, both in bumper-to-bumper traffic and on long road trips.

V2V communication technology could mitigate many traffic collisions and improve traffic congestion by sending and receiving basic safety information such as location, speed and direction of travel between vehicles that are approaching each other. It will warn drivers and can supplement active safety features, such as forward collision warning, already available on many production cars.

As the world becomes more congested and new populations need access to personal mobility, accidents continue to be a global concern. A recent National Highway Traffic Safety Administration study estimated that the economic and societal impact of motor vehicle crashes in the United States is more than \$870 billion per year.

“Advancing technology so that people can more safely live their lives is a responsibility we embrace,” Barra said.

**Cadillac** has been a leading luxury auto brand since 1902. Today Cadillac is growing globally, driven by an expanding product portfolio featuring dramatic design and technology. More information on Cadillac appears at [www.cadillac.com](http://www.cadillac.com). Cadillac's media website with information, images and video can be found at [media.cadillac.com](http://media.cadillac.com).

**General Motors Co.** (NYSE:GM, TSX: GMM) and its partners produce vehicles in 30 countries, and the company has leadership positions in the world's largest and fastest-growing automotive markets. GM, its subsidiaries and joint

venture entities sell vehicles under the Chevrolet, Cadillac, Baojun, Buick, GMC, Holden, Jiefang, Opel, Vauxhall and Wuling brands. More information on the company and its subsidiaries, including OnStar, a global leader in vehicle safety, security and information services, can be found at <http://www.gm.com>

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**Appendix XVII. USDOT, U.S. Department of Transportation Announces up to \$42 Million in Next Generation Connected Vehicle Technologies (“USDOT Announces \$42 Million”).**



## Intelligent Transportation Systems - News

### U.S. Department of Transportation Announces up to \$42 Million in Next Generation Connected Vehicle Technologies

*New York City, Tampa, FL and Wyoming Selected for Competitive Pilot Programs*

WASHINGTON – Today, U.S. Transportation Secretary Anthony Foxx made a major announcement on the future of vehicles that will make driving safer, cleaner, and more efficient. At the New York City Joint Management Traffic Center, the Secretary revealed that New York City, Wyoming, and Tampa, FL will receive up to \$42 million to pilot next-generation technology in infrastructure and in vehicles to share and communicate anonymous information with each other and their surroundings in real time, reducing congestion and greenhouse gas emissions, and cutting the unimpaired vehicle crash rate by 80 percent.

As part of the Department of Transportation (USDOT) national Connected Vehicle Pilot deployment program, the locations were selected in a competitive process to go beyond traditional vehicle technologies to help drivers better use the roadways to get to work and appointments, relieve the stress caused by bottlenecks, and communicate with pedestrians on cell phones of approaching vehicles.

"Today's announcement is a big step forward for the future of how we move in this country, from our rural communities to our biggest cities," said Transportation Secretary Anthony Foxx. "It has been a core mission of the Department to support promising new technologies, and through these types of smart investments we are opening the door to a safer and cleaner network and expanding how future generations travel."

New York City will install Vehicle to Vehicle (V2V) technology in 10,000 city-owned vehicles; including cars, buses, and limousines, that frequently travel in Midtown Manhattan, as well as Vehicle to Infrastructure (V2I) technology throughout Midtown. This includes upgrading traffic signals with V2I technology along avenues between 14th Street and 66th Street in Manhattan and throughout Brooklyn. Additionally, roadside units will be equipped with connected vehicle technology along the FDR Drive between 50th Street and 90th Street.

U.S. DOT made an additional commitment to empowering cities to solve congestion and safety issues with connected vehicle technology by awarding \$17 million to solve peak rush hour congestion in downtown Tampa and to protect the city's pedestrians by equipping their smartphones with the same connected technology being put into the vehicles. Tampa also committed to measuring the environmental benefits of using this technology.

In Wyoming, the focus is on the efficient and safe movement of freight through the I-80 east-west corridor, which is critical to commercial heavy-duty vehicles moving across the northern portion of our country. Approximately 11,000 to 16,000 vehicles travel this corridor every day, and by using V2V and V2I, Wyoming DOT will both collect information and disseminate it to vehicles not equipped with the new technologies.

These connected vehicles will yield unprecedented levels of anonymous data that will be the basis for a multitude

of innovative applications that will lead to smart vehicles, smart infrastructure, and ultimately smart cities. Research has found that the technology could reduce unimpaired vehicle crashes by 80 percent, while also reducing the 4.8 billion hours that Americans spend in traffic annually.

In 2012, the USDOT tested and proved connected vehicles' life-saving potential in the largest real-world pilot of the technology to date, with over 2,700 equipped vehicles operating on the streets of Ann Arbor, Michigan. Participating vehicles used V2V safety technology to help everyday drivers avoid crashes as they traveled along their normal routines. Safety apps warned drivers of alerts such as braking vehicles ahead, vehicles in their blind spots, or impending red-light violations. USDOT's efforts proved that connected vehicle technology indeed works in the real world and in a variety of vehicle types including cars, trucks, transit vehicles, motorcycles, and even bicycles.

The high level of interest that was prompted by the announcement of the Connected Vehicle Pilot Deployment Program is a testament to the promise of connected and automated vehicles. With the Connected Vehicle Pilot Deployment Program, the USDOT is now focusing on accelerating the deployment of the technology in more regions throughout the nation. The USDOT's goals for the program are straightforward—advance deployment, measure impact, and uncover and address the technical and non-technical barriers to deployment in a hands-on way.

In addition, the Department announced in May steps to accelerate road safety innovation, including accelerating its timetable on a proposed rulemaking that will require the installation of V2V communications equipment in all new vehicles. The proposal is expected by the end of 2015. New cars with connected vehicle technology could be in our showrooms as early as 2016.

There will more information about future pilot deployments in the coming months.”

**For More Information:** To learn more about the ITS JPO's Connected Vehicle Pilot Deployment Program, visit: <http://www.its.dot.gov/pilots/>.

**Appendix XVIII. Press Release, Colorado Dept. Transp., HERE and Colorado Department of Transportation Announce First of its Kind Connected Vehicle Project in North America (Jan. 11, 2016).**

# HERE and Colorado Department of Transportation Announce First of its Kind Connected Vehicle Project in North America — Colorado Department of Transportation

You are here: [Home](#) / [News](#) / [2016 News Releases](#) / [01-2016](#) / HERE and Colorado Department of Transportation Announce First of its Kind Connected Vehicle Project in North America

## HERE and Colorado Department of Transportation Announce First of its Kind Connected Vehicle Project in North America

January 11, 2016 - Statewide Transportation Plan - CDOT and HERE RoadX pilot targets I-70 Mountain Corridor to Maximize Driver Safety and Roadway Efficiency.

**Denver, CO – January 11, 2016** — Denver, CO – The Colorado Department of Transportation (CDOT and HERE, a leader in mapping and location technology, announced today the first cellular network-based connected vehicle alert system in North America.

At the forefront of Intelligent Transportation Systems, the project aims to help maximize driver safety and roadway efficiency along one of the most challenging roads in the United States. The I-70 Mountain Corridor links Denver to Colorado's world-class resorts and mountains. Every year, millions of travelers face extreme weather, high altitude driving and significant congestion, costing billions in lost time and revenue.

"As vehicles share safety hazards in near real time via cellular networks and with the HERE location cloud, the I-70 Mountain Pilot will transform data into intelligence, helping vehicles safely and more efficiently get to their destination," said CDOT Executive Director Shailen Bhatt.

CDOT plans to leverage the HERE Location Cloud and Digital Transportation Infrastructure solution (DTI), on the RoadX Connected Vehicle pilot to connect vehicles, smartphones and other devices, road infrastructure and traffic management centers. Utilizing existing cellular networks, the HERE Location Cloud, along with DTI are capable of ingesting, analyzing, and distributing highly accurate, safety critical information such as accidents or extreme weather to the right people at the right time. The HERE platform is interoperable, which will enable seamless data sharing with CDOT, and is optimized for the continued integration of data generated by a vehicle's on-board sensors and the surrounding road infrastructure.

The project with HERE is the first industry collaboration announced by CDOT following the launch of their RoadX program in October with US Secretary of Transportation Anthony Foxx.

"HERE is proud to work with the Colorado Department of Transportation as we lead the way in turning the promise of connected vehicle technology into reality. We have designed an interoperable platform that today allows an efficient low latency data exchange, where connected vehicles can transmit and receive localized information on road conditions for the safety and benefit of the driver," said George Filley, Global Head of Digital Transportation

## Infrastructure at HERE.

The I-70 Mountain Pilot builds on HERE's work with the Finnish Transport Agency's Nordic Way project, which was the first deployment of HERE DTI in support of C-ITS (Cooperative Intelligent Transport Systems) based on the Location Cloud capabilities in conjunction with cellular networks. With the successful completion of phase one, transportation agencies can see a path to solving many challenges without additional costly roadside infrastructure. HERE is also working with the Dutch government to deploy a similar ITS program in the Netherlands.

"RoadX efforts like the collaboration with HERE are investments that we believe are smart with our taxpayer dollars," added Bhatt. "It is an investment in our time as commuters, our bottom lines as businesses and our lives as travelers on our roadways. It is time for our state to take the leading role in a major innovation in travel and in Colorado's economic future."

CDOT will be seeking approximately 1000 vehicles to participate in the pilot which will begin during the 2016-2017 winter ski season.

"The innovative RoadX project will demonstrate how available cellular technology can be used to address real challenges in transportation. It is a very astute decision by CDOT to deliver these critical driver alerts at a fraction of the cost compared to a DSRC-based connected vehicle implementation," said Praveen Chandrasekar, an automotive and transportation industry analyst at global research and consulting firm Frost & Sullivan. "HERE is a recognized leader in the marketplace, and their ITS projects throughout the world are helping to lay the foundation for the future of traffic management and connected vehicle technology."

To read an interview with CDOT Executive Director Bhatt and learn more about the project, be sure to go to <http://360.here.com>.

### About HERE

HERE is a leader in mapping and location technology. We enable rich, real-time location applications and experiences for consumers, vehicles, enterprises and cities. HERE is backed by a consortium of leading automotive companies. To learn more about us, including our work in the areas of connected and automated driving, visit [360.here.com](http://360.here.com).

### About Colorado's RoadX

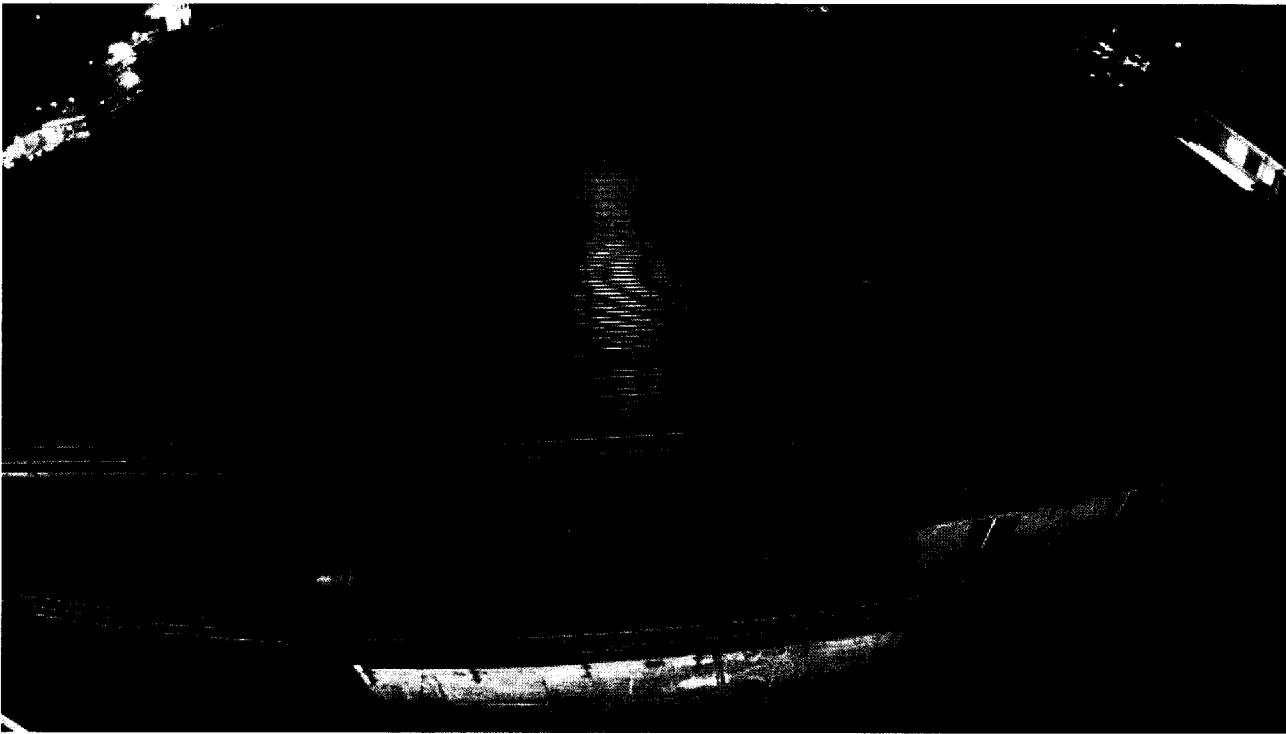
RoadX is Colorado's bold vision and commitment to being a national leader in the partnerships and use of innovative technology for crash-free, injury-free, delay-free travel in Colorado. To learn more about this rapid, fast-paced venture to transform our aging transportation system, visit <https://www.codot.gov/programs/roadx>.



**Appendix XIX. Hoku Paa, Joint Traffic Management Center.**

# Joint Traffic Management Center Home

Joint Traffic  
Management Center  
**Current Construction Photo**



Honolulu's Joint Traffic Management Center (JTMC) is a multi-agency collaboration to improve traffic management and public safety coordination on O'ahu. The Center will facilitate coordination among six agencies:

## *City & County of Honolulu*

- Department of Transportation Services (DTS)
- Honolulu Police Department (HPD)
- Honolulu Fire Department (HFD)
- Emergency Services Department (ESD)
- Honolulu Authority for Rapid Transportation (HART)

## *State of Hawaii*

- Hawai'i Department of Transportation (HDOT)

## **JTMC Mission**

The JTMC will provide a secure, protected, comfortable, collaborative, and enabling environment that will allow traffic management and Public Safety Answering Point (PSAP) personnel on O'ahu to improve and enhance:

- Day-to-day operation of the transportation network;
- Coordination and response to traffic incidents, reducing traffic delays and congestion and improving public safety;
- Information dissemination among responders; and
- Traffic information disseminated to the public.

### Active Traffic Management

At the JTMC, a combination of people and automated systems will integrate information from various sources to support a proactive response to traffic operations. The JTMC will manage traffic during the range of traffic flow conditions including both major and minor congestion as well as incidents and events. To this end, the stakeholder agencies — led by DTS and HDOT — will actively manage traffic while the JTMC supplies the environment for City and State traffic operations and City first responder agencies to work together to improve traffic.

The “active” part of ATM consists of two elements: (1) continuous monitoring through technologies and people, and (2) proactively changing traffic control and management to respond to, or in anticipation of, traffic conditions through automated technologies and staff monitoring.

### Hoku Pa`a and JTMC Logo

The chosen name for the JTMC is *Hōkū Pa`a* — the Hawaiian phrase for “North Star,” literally translated as “Immovable Star.” Like the guiding star, the JTMC serves as a trusted resource and a constant reference point that enhances the roadway travel experience while simultaneously protecting all travelers.

The JTMC logo image embodies the shape of a shield, with three distinct elements: the seven-pointed star, the *Pueo*, and a roadway.

- The seven-pointed star personifies *Nā Huihui o Makali`i*, a cluster of stars that served as a guiding constellation in the traditional Hawaiian star-based calendar and represents the six JTMC agencies coming together as one.
- The *Pueo*, or Hawaiian Short-eared Owl, draws a parallel between the wisdom of the revered bird and the wealth of knowledge the JTMC imparts. Like the protector and messenger owl, the JTMC is a guardian chaperone that provides direction and reassurance.
- The vertical lines forming the roadway at the bottom of the logo are representative of both the ancient trails that guided *Kanaka Maoli* from *uka* to *kai* and the modern roadways that safely and efficiently connect our people to each other and their livelihood.

### JTMC Building Design

The architectural design of the JTMC building was inspired and informed by the traditions of Pacific voyaging and navigation. The overall theme of the structure honors and recognizes the successful revival and perpetuation of Polynesian and Hawaiian voyaging and the lessons learned from Micronesian Master Navigator Mau Piailug.



The JTMC is primed and vigilant, steadfast in its commitment to perpetually support daily commutes for optimal safety and efficiency.

**Contact Information**

Department of Transportation Services

Phone: 808-768-8303

Last Reviewed: June 10, 2015

**Appendix XX. Colorado Dept. Transp., *Colorado's Vision: RoadX.***



# Colorado's Vision: RoadX

Where Transportation  
and Technology Intersect





# WHAT IS ROADX?

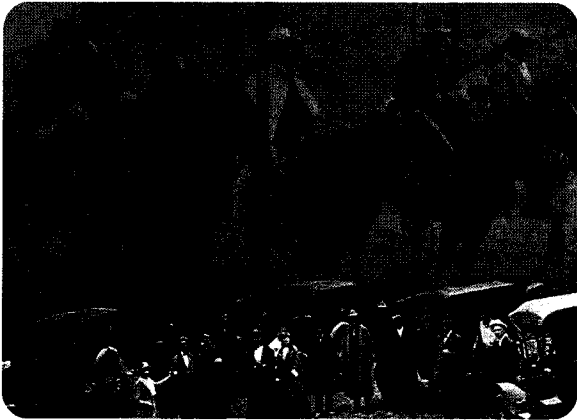
**RoadX is Colorado's bold vision and commitment to being a national leader in the use of innovative technology to improve the safety, mobility and efficiency of the transportation system, fostering the continued economic vitality of our state.**

It is a rapid, fast-paced venture that will enable the Colorado Department of Transportation (CDOT) to build the roadways of tomorrow - today. RoadX will create an environment where industry has a direct connection with a state that is committed to deploying comprehensive technological solutions to transform an aging transportation system.

Crash-free, injury-free, delay-free and technologically-transformed travel in Colorado.

Team with public and industry partners to make Colorado one of the most technologically advanced transportation systems in the nation, and a leader in safety and reliability.

# WHY IS NOW THE TIME FOR ROADX?



History has vividly illustrated that humanity thrives when it has the ability to travel unobstructed. In the 20th century, man achieved unequalled leaps in travel around the world and even to the moon. Nationally and especially in Colorado, over the last 100 years, we have seen incredible leaps in progress and economic vitality when we have invested in our transportation system.

In the late 1800s, a group of businessmen formed the Denver Chamber of Commerce with the express purpose to raise the funds necessary to ensure the railroad came to Colorado. This entrepreneurial mindset forever changed the landscape of Colorado.

In 1910, the first Colorado Transportation Commission was formed, conducting primary business via horseback. In less than 10 years, roads and motor vehicles were crisscrossing Colorado. The radical paradigm shift on what defined personal transportation was underway.

More recently, Coloradans embarked on two leaps of commitment and ingenuity. The first was moving Denver International Airport, transforming how we connected the world to Colorado. The second was voters approving FasTracks in 2004, the metro-wide light rail, commuter rail and bus rapid transit system that is reshaping our transportation landscape and changing how we choose to travel.

Today, we face several monumental challenges in our fundamental endeavor to make great achievements in transportation and mobility.

- 1 Vision for the Future** – Our transportation system is based on “Model T” technology and the decades of long-term planning and building of our transportation system has developed into an environment and culture where innovation has declined.
- 2 Safety & Reliability** – Though we enjoy more ease of travel than at any other time in history, traffic related deaths and serious injuries, and the resulting unreliability of the transportation system, tarnish our achievements as an industry.
- 3 Economic Vitality** – Our state’s economic vitality is directly tied to the capacity to move people, goods and information. Growth-caused congestion stifles that vitality and potential for future growth.
- 4 Funding** – Our economic success is largely dependent upon the success of our transportation system, yet Colorado’s approach to funding transportation hinders our ability to markedly improve our transportation system in the traditional fashion.
- 5 Rapid Technological Advancement** – While manual control of a vehicle is still predominant in 2015, before a person born today reaches his 18th birthday - that will all change.



**Although man reached the moon in the last century, our achievement in travel on the earth has slowed in this century. We have been trying to shape Colorado's 21st Century destiny with 20th Century transportation solutions.**

We are heirs to a system we don't have the resources to adequately maintain, rebuild or expand.

Today;

Colorado ranks 32nd out of 50 states in the quality of our pavement.

Our metro areas in Denver and Colorado Springs are some of the most congested cities in the country, metro Denver ranking 19th worst in congestion and 16th worst in trip reliability.

Our populations grew by 50 percent in the last 20 years and will grow by another 50 percent in the next 20.

In 2014, 488 people died in traffic related crashes using Colorado's transportation system and another 3,219 were seriously injured.

In 2014, the cost of all crashes in Colorado was \$13.27 billion, or approximately \$2,500 per person.

Congestion in Denver/Aurora costs \$1,101 per commuter per year.

Today's mobility solutions still reinforce the nation's dependence on imported sources of energy and impact greenhouse gas emissions.

Historically, the approach to these challenges was to add more lanes to the system, an expensive proposition that has resulted in an \$800 million a year funding gap and a legacy system that we do not have the funds to fully maintain. We have learned - we cannot just build our way out of congestion.

As shown with the advent and rapid adoption of the personal computer, the Internet and smart devices - technological deployment dramatically changes how we do business, impact our environment, live our lives and spend our time.

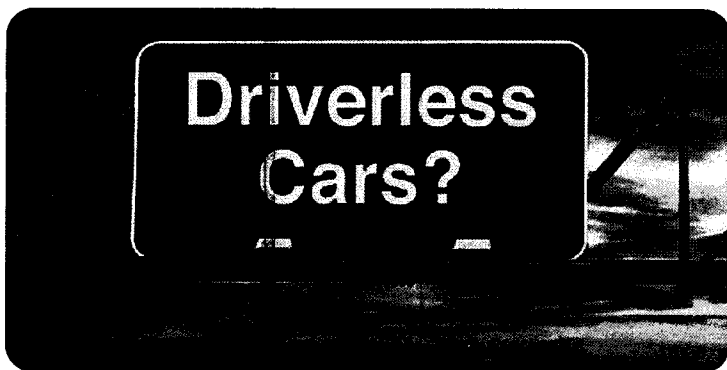
Transportation and mobility have yet to fully benefit from these advancements.

The Colorado Department of Transportation (CDOT) is convinced that the integration of technology is the next logical step. And, while we know that a new technological focus in transportation does not guarantee Colorado will achieve all of its strategic goals; we know that a failure to do so guarantees we will not achieve any.

RoadX is Colorado's commitment to being a national leader in the rapid and aggressive implementation of innovative technology to revolutionize the safety, mobility and efficiency of our transportation system within the next 10 years, and that commitment starts now.

**CDOT understands that the integration of technology and transportation is the logical - and inevitable - next step.**

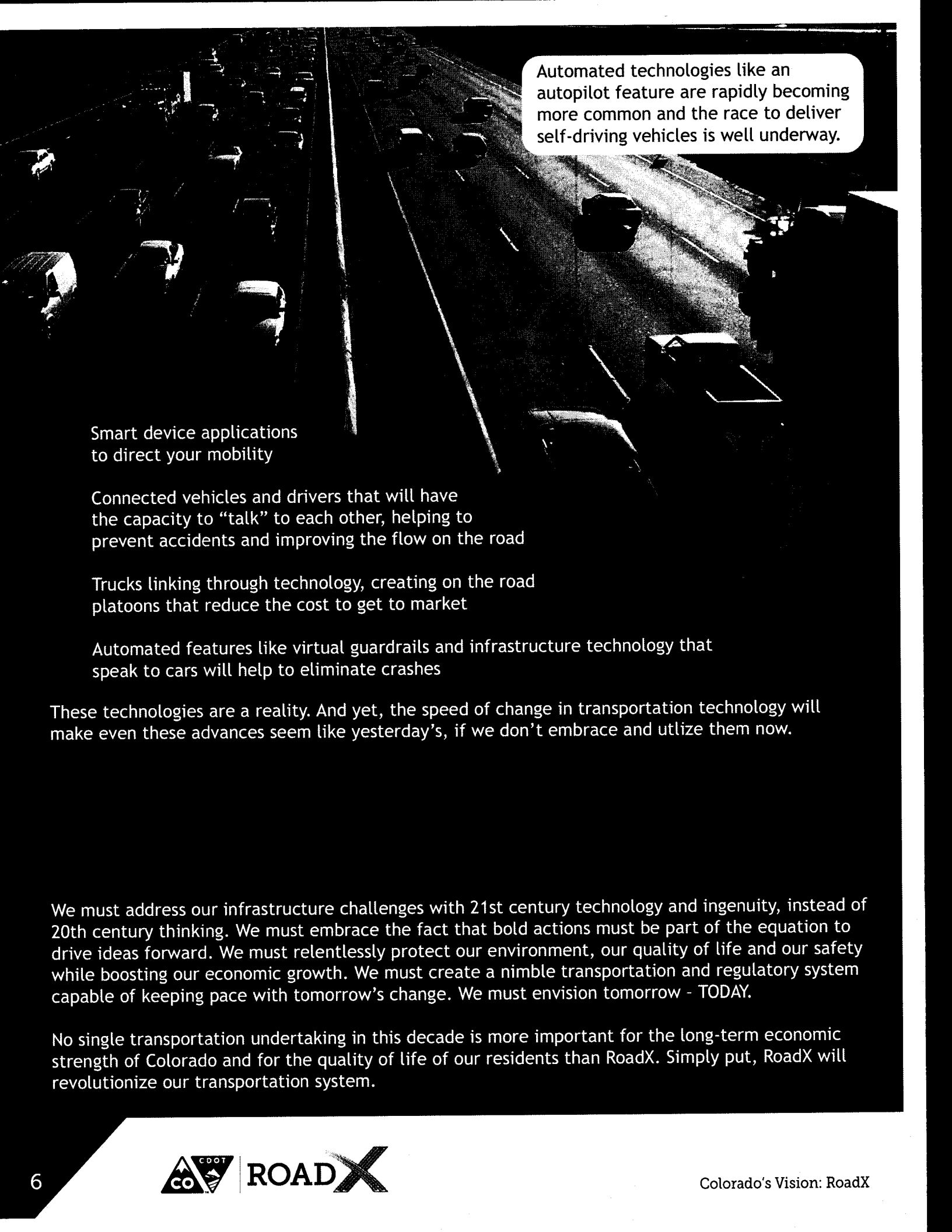
# ROADX PUTS COLORADO IN THE DRIVER'S SEAT



Just as we made the radical shift in 1910 from horses to cars, the transportation industry is again at a crossroads. Over the next several years, virtually all of the major car manufacturers will offer vehicles to the public that can take over highway driving, manage traffic jams or protect someone from a crash. Many already offer features that let the car do the driving for periods of time on straight stretches of road. Other innovators are working on applications that can be

applied to vehicles aftermarket to assist drivers. Self-driving cars have logged thousands of miles and Silicon Valley has entered the car market.

Self-driving cars are only one of the radical changes. We have entered an era where big data can be leveraged to assess real-time and historical roadway conditions and provide more efficient decision making for vehicles and drivers. New on-demand mobility companies in the new "sharing economy" are reshaping how people think about mobility, turning it into a real-time service to be used when needed. RoadX puts Colorado in the driver's seat to ensure our state benefits from significant advances, including:



Automated technologies like an autopilot feature are rapidly becoming more common and the race to deliver self-driving vehicles is well underway.

Smart device applications to direct your mobility

Connected vehicles and drivers that will have the capacity to “talk” to each other, helping to prevent accidents and improving the flow on the road

Trucks linking through technology, creating on the road platoons that reduce the cost to get to market

Automated features like virtual guardrails and infrastructure technology that speak to cars will help to eliminate crashes

These technologies are a reality. And yet, the speed of change in transportation technology will make even these advances seem like yesterday's, if we don't embrace and utilize them now.

We must address our infrastructure challenges with 21st century technology and ingenuity, instead of 20th century thinking. We must embrace the fact that bold actions must be part of the equation to drive ideas forward. We must relentlessly protect our environment, our quality of life and our safety while boosting our economic growth. We must create a nimble transportation and regulatory system capable of keeping pace with tomorrow's change. We must envision tomorrow - TODAY.

No single transportation undertaking in this decade is more important for the long-term economic strength of Colorado and for the quality of life of our residents than RoadX. Simply put, RoadX will revolutionize our transportation system.



# ROADX ACTION PLAN

## WHO IS ROADX?



RoadX will be a collaborative enterprise focused on building partnerships, entrepreneurial relationships and delivering innovative solutions. CDOT is seeking to convene a RoadX InnoVisers Council, tapping innovators and advisors from within the state, across the nation and worldwide, as well as leaders from public and private industry, to guide the integration of technology into Colorado's transportation system.

**COLORADO IS OPEN FOR BUSINESS** - Bring us your expertise and solutions! We need industry to get involved in the identification of the best technological solutions.

## HOW WILL ROADX BE FUNDED?

CDOT's annual budget is \$1.4 billion dollars. Each year, we spend hundreds of millions of that budget to improve the safety and mobility of the traveling public. Recent developments in technology are bringing about opportunities to achieve the same goals through less capital construction and the deployment of more technology solutions.

CDOT is committing \$20 million in funding over the next year to obtain congestion relief and safety improvements through the deployment of technology, to kick-start RoadX. CDOT is currently adjusting its policies so funding categories further align with the integration of technology in transportation and mobility. Each year, as we realize the full benefits of these projects, CDOT is committed to investing more in technology to obtain our goals of safely moving people and promoting Colorado's economy.



The managed motorways project in Australia utilized ramp metering for all of its on and off ramps and used complex computer algorithms to control the access and exits on the highway.



Maximize throughput on the interstate and maintain a constant flow of traffic.



An increase in traffic speeds of 35% to 60% during peak times.

# ROADX 2016: INDUSTRY CALL TO ACTION

We have the vision. You have the knowledge.

Our business proposition is simple: Increase investment in technology resulting in a superior return on the state's investment in funds, safety and mobility.

Colorado's vision to transform our state's transportation system into one of the safest and most reliable in the nation by harnessing emerging technology begins with our commitment to:

Providing industry access to key state assets for statewide transportation technology deployment partnerships

Offering an industry-friendly technology partnering environment at all levels of public policy - state, regional and local

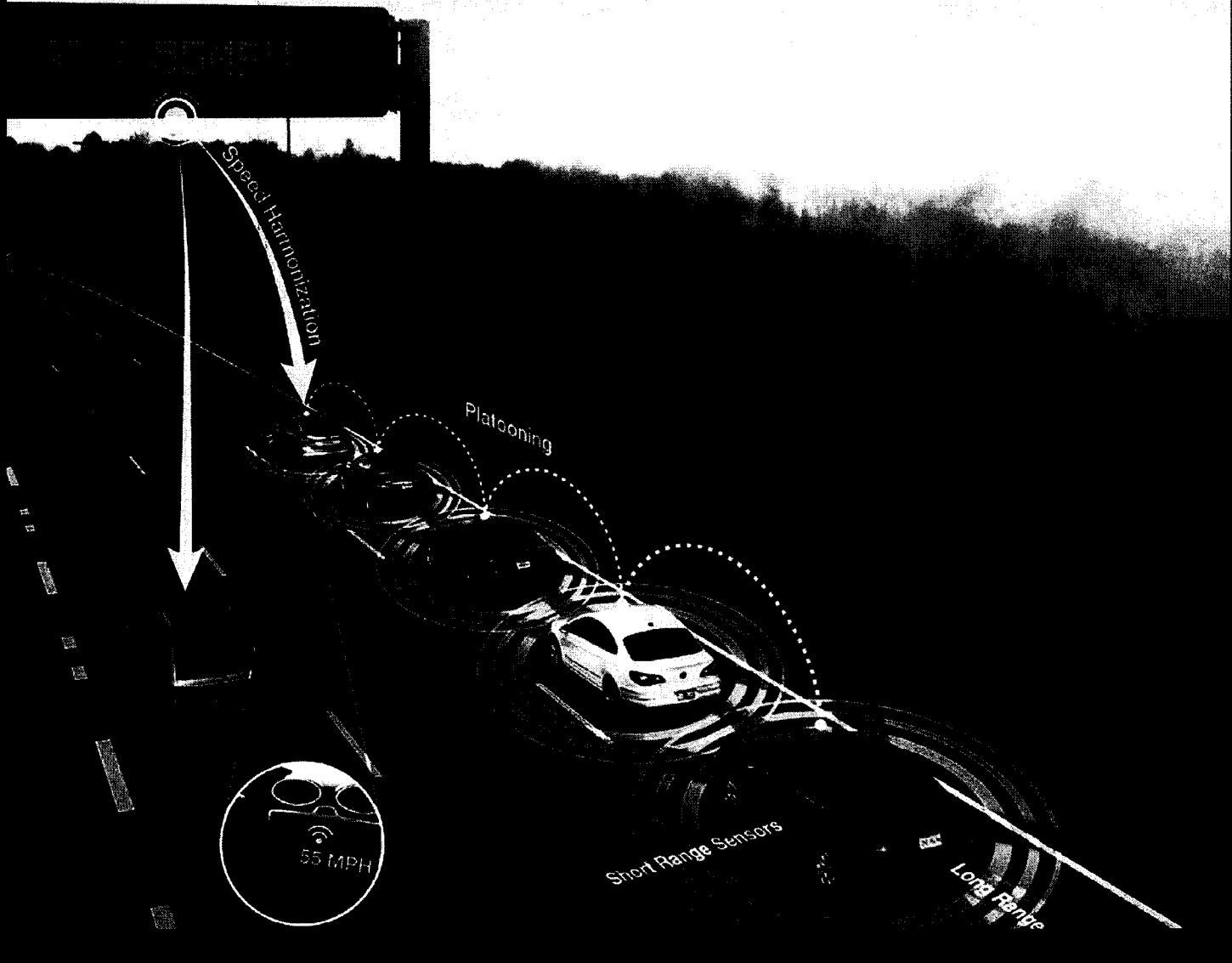
Funding \$20 million of foundational technology projects in June of 2016, with like amounts anticipated in future fiscal years

Accelerating the re-allocation of CDOT's annual \$1.4 billion budget from hard capital asset investment to invest in technological solutions as rapidly as industry can provide innovation that meets CDOT's transportation goals

## What We Need:

While Colorado has the ability to fund and begin individual technology-related pilot projects, we recognize the importance of ensuring that 1) each project has industry input, and 2) these projects all provide an interconnected foundation that builds toward our ultimate vision - the transformation of our transportation system. We are looking for the technology industry to:

- Partner with Colorado to make RoadX come to life as soon as possible by identifying the organizational structure, regulatory and policy changes, funding needs, an accelerated schedule, etc., necessary for CDOT to establish an environment that will successfully attract private sector partners to help Colorado achieve its RoadX Capstone Project (Appendix A)
- Offer specific ideas for implementation of 2016 - 2017 Foundational RoadX Technology Projects (Appendix B)
- Identify the baseline requirements for successfully merging technology and transportation





Capstone Project Vision: Crash-free, injury-free and delay-free travel by maximizing the efficient use of infrastructure.

Technology has the potential to dramatically influence innovative roadway utilization, such as narrowing lanes and shoulders to accommodate more travel lanes. While many believe this will take several decades to accomplish, CDOT aims to accelerate this process by partnering with industry - our lives and our economy depend on it.

In 2016, CDOT will begin to explore partnership opportunities to implement its first RoadX Corridor, to be explicitly used by vehicles with automated freeway driving capabilities. This will be accomplished through the conversion of an existing managed lane, building new lanes or converting shoulders.

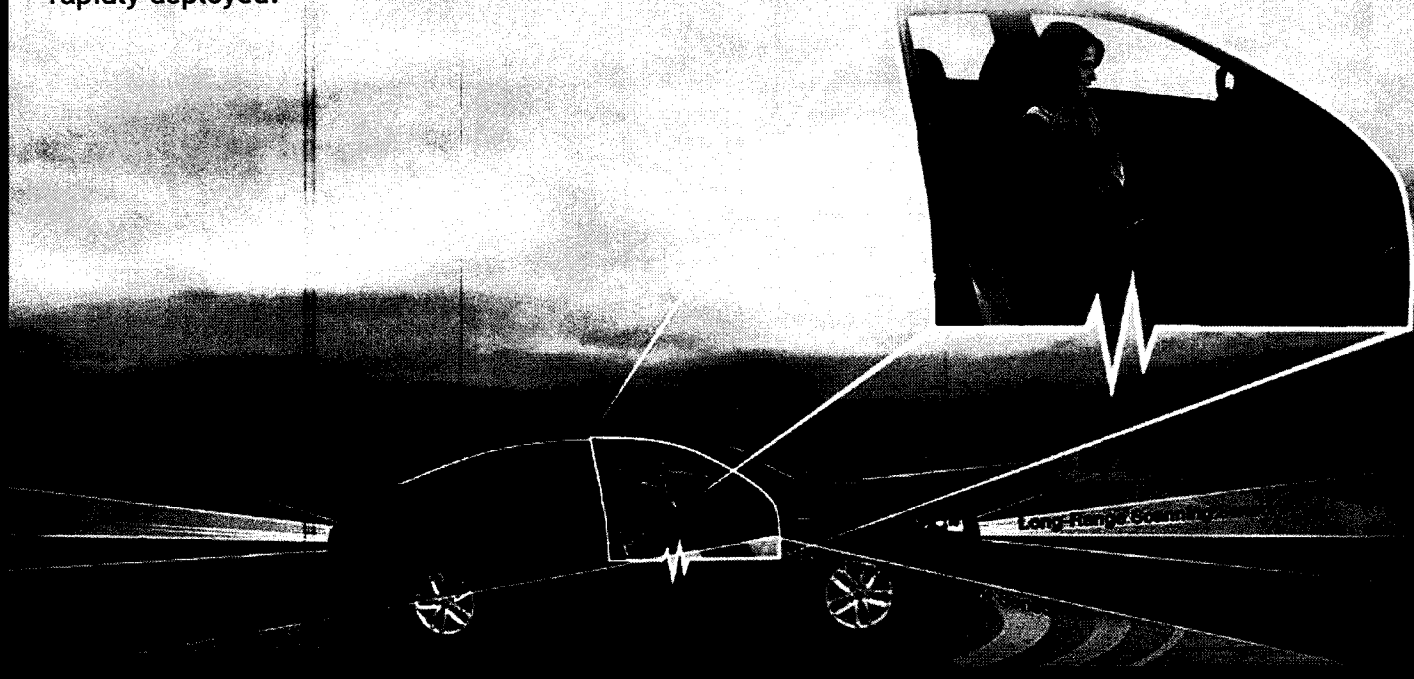
## The RoadX Corridor under this model could provide the following benefits:

- Reduce crashes
- Improved throughput and reliability
- Incentivize the use of automated vehicles and accelerate their market penetration
- Provide safety and mobility benefits on roads other than the RoadX Corridor
- Vividly showcase the potential of a highly technologically advanced vehicle fleet and transportation infrastructure to improve safety, reliability and efficiency

## Other RoadX Capstone Projects could include:

- Reconfiguring freeway and/or arterial facilities to maximize efficiency of all travel and yield benefits of advanced technology vehicles
- Connected vehicle technologies
- Electric vehicle supporting technology
- Use of advanced data collection and analytics
- Demand management strategies
- Transportation systems management strategies
- Weather management technologies and strategies

CDOT commits to providing an environment where private industry innovation has the opportunity to grow commercially while providing benefits in transportation performance. The RoadX Capstone Projects are not focused on achieving slow and incremental benefits, but rather solutions that are comprehensive and holistic in their nature that work toward exponential improvements in the travel experience and performance of the system. CDOT's intent is not to prescribe solutions, but to foster the environment where partnerships can flourish, true innovation can occur and solutions can be rapidly deployed.



# Appendix B

## 2016 Action Plan: Foundational RoadX Technology Projects

**CONNECTION:** Transform Colorado into the most data-connected transportation system in the nation.

**TRANSPORT:** Transform Colorado into the safest and most efficient freight transport system in the nation.

**COMMUTING:** Transform Colorado into the most reliable transportation system for commuting in the nation.

**SAFETY:** Make a dramatic leap towards zero deaths on Colorado roadways.

**INTEGRATION:** Transform the state and its communities into the most technologically advanced in the nation by integrating a technology culture into all of our processes, workforce and systems.

This section outlines projects identified for 2016 - 2017 within each of these five action areas. Each is intended to improve the safety, mobility and/or efficiency of Colorado's transportation system and build toward the Capstone Projects.

We are looking to the technology industry to:

Help identify the best technological solutions for each of the focus areas and/or specific 2016 - 2017 projects outlined in this appendix

Analyze and determine how these focus areas and foundational projects should inter-relate to support the accelerated achievement of Colorado's Capstone Projects

Suggest any alternate projects that should be considered for early exploration, testing or deployment, based on Colorado's Capstone Projects

## CONNECTION

**Description:** Engage industry to develop solutions to transform data into actionable intelligence and deliver to drivers, cellular/mobile applications and connected and autonomous vehicles.

**Project #1: Interoperable Data Platform:** Deploy a web-based, open source safety, traffic and transportation system data platform capable of communicating with a diverse collection of drivers, cellular/mobile applications, and connected and autonomous vehicles to deliver critical real-time, actionable information and safety voice alerts such as multi-vehicle pileups, rock falls, avalanche slides, white-out/fog-out low visibility, wrong-way drivers, runaway trucks, stopped vehicles, incident advisory, icy roads, emergency vehicles, curve speed warnings, intersection hazards, work zone warnings, sun glare warnings.

Statewide

Industry engagement by Dec. 2015;  
Solicit industry solutions by Feb. 2016

\$1 million

**Project #2: I-70 Connected Vehicle Pilot Deployment:** Maximize safety and mobility on the I-70 mountainous corridor through probe data collection, vehicle-to-infrastructure (V2I) communication, and related decision support analysis to enable real time traffic management and traveler information and safety applications.

I-70 (Vail-DIA)

Seeking input from industry by  
June 2016

\$10 million

## TRANSPORT

**Description:** Deploy emerging in-vehicle technology and supporting infrastructure to improve the safety and efficiency of transporting freight.

**Project #1: Industry Focused Pilot:** Partner with a key industry in Colorado, with the goal of reducing the cost of transporting goods, improving the bottom line and impact to local roads by outfitting selected commercial vehicle fleet vehicles with vehicle-to-vehicle and vehicle-to-infrastructure technologies and deploy supporting infrastructure and systems to support truck platooning, frontal collision avoidance, etc.

With industry input, possibly US  
85, I-76 or I-25 Co Springs-Ft.  
Collins, as well as state  
highways in northern Colorado

Request for Partners issued by end  
FY 2016

\$3 million



Description: Deploy technology systems and infrastructure systems to improve the reliability of travel times and offer optimized routing and movement of commuters.

Implement advanced ramp meters and traffic management systems to facilitate mainline interstate and arterial roadway traffic management.

I-25 from RidgeGate to  
Broadway in metro Denver

RFP by end FY 2016

\$7 million

Description: Deploy advanced technology systems and infrastructure systems to improve the safety of Colorado roadways.

Transform a rural State Highway into the safest corridor in the state with goal of zero deaths using technologies such as connected vehicles, smart infrastructure (virtual guardrails, smart lane markings, etc.)

Southeast and southwest  
Colorado

Request for Partners by end of  
FY 2016

\$3 million



## Project #2: Striping Improvements

Description: The reflectivity and durability of roadway pavement markings will allow vehicles that use these marking for guidance and lane designations to be utilized on more roads in Colorado. Additionally, an immediate benefit can be realized for the traveling public today.

Major Corridors Statewide

2016 and Beyond

\$3 million to \$5 million above  
already-programmed funds

## INTEGRATION

Description (Planning): Enable a planning framework that ensures technology and operational innovations are embedded into the overall transportation planning framework.

Project #1: Technology Planning Process: Develop NEPA/environmental evaluation process that effectively includes technology and operation innovations as a significant part of the alternatives analysis. For projects already past the environmental evaluation process, develop a "RoadX" clearance process to ensure all alternatives are incorporated as a project moved into design.

Statewide

Issue RFP for consultant support by end FY 2016

\$1 million

Description (People): Ensure that CDOT has the human capital and resources to understand and effectively integrate innovative technologies while transforming how the department "does business."

Project #1: Workforce of the Future Analysis: Conduct scenario planning to prepare for the types of employees and skills that will be necessary to implement RoadX in addition to other future roles.

Statewide

RFP has been issued

\$2 million

Project #2: Engineering Training Program: Develop a nation-leading, comprehensive Engineering in Training program that includes a two-year rotation in several necessary skill sets including: technology/operations, planning, communications, economic development, engineering (materials, bridges, roads, assets), maintenance, project management, cash management, contracts. Goal is to recruit nation-wide to train the best and brightest.

Statewide

RFP for consultant support by end FY 2016

\$1 million

# Where Transportation and Technology Intersect

303-757-9033

[dot\\_roadx@state.co.us](mailto:dot_roadx@state.co.us)

[codot.gov/programs/roadx](http://codot.gov/programs/roadx)



**Appendix XXI. Press Release, USDOT, U.S. Department of Transportation Announces  
Columbus as Winner of Unprecedented \$40 Million Smart City Challenge  
(June 23, 2016).**

## U.S. Department of Transportation Announces Columbus as Winner of Unprecedented \$40 Million Smart City Challenge

*Paul G. Allen's Vulcan Inc. awards additional \$10 million*

COLUMBUS, OH – U.S. Transportation Secretary Anthony Foxx announced today that Columbus, OH has been selected as the winner of the U.S. Department of Transportation's (U.S. DOT)'s [Smart City Challenge](#). As winner of the Challenge, Columbus will receive up to \$40 million from U.S. DOT and up to \$10 million from Paul G. Allen's Vulcan Inc. to supplement the \$90 million that the city has already raised from other private partners to carry out its plan. Using these resources, Columbus will work to reshape its transportation system to become part of a fully-integrated city that harnesses the power and potential of data, technology, and creativity to reimagine how people and goods move throughout their city.

"Each of the seven finalists put forward an array of thoughtful, intelligent, and innovative ideas that defined a vision for the future of the American city and formed a blueprint to show the world what a fully integrated, forward-looking transportation network looks like," said Secretary Foxx. "The Smart City Challenge required each city to think about transportation as cross-functional, not in silos, but as a transportation ecosystem. The bold initiatives they proposed demonstrated that the future of transportation is not just about using technology to make our systems safer and more efficient – it's about using these advanced tools to make life better for all people, especially those living in underserved communities. While Columbus is the winner of the Challenge, we believe each city has come out of this process with a stronger sense of how to address transportation challenges with technology and innovation."

"We are thrilled to be America's first Smart City. Our collaboration between public, private and nonprofit sectors is the perfect example of how we lift up our residents and connect all communities," said Mayor Andrew Ginther. "Smart Columbus will deliver an unprecedented multimodal transportation system that will not only benefit the people of central Ohio, but potentially all mid-sized cities. I am grateful to President Obama, Secretary Foxx, the U.S. Department of Transportation, all of our partners and especially the Smart Columbus team."

The Smart City Challenge generated a significant amount of excitement and interest amongst cities. U.S. DOT received seventy-eight applications in total – one from nearly every mid-sized city in America. The Challenge called on cities to do more than merely introduce new technologies onto city streets, requiring them to boldly envision new solutions that would change the face of transportation in our cities by closing the gap between rich and poor; capturing the needs of both young and old; and bridging the digital divide through smart design so that the future of transportation meets the needs of all city residents.

The seven finalist cities that were announced at South by Southwest (SXSW) in March – Austin, Columbus, Denver, Kansas City, Pittsburgh, Portland, and San Francisco – rose to the Smart City Challenge in an extraordinary way. They presented innovative concepts, proposing to create new first of a kind corridors for autonomous vehicles to move city residents, to electrify city fleets, and to collectively equip over thirteen thousand buses, taxis, and cars with vehicle-to-vehicle (V2V) communication.

Columbus was selected as the winner because it put forward an impressive, holistic vision for how technology can help all of the city's residents to move more easily and to access opportunity. The city proposed to deploy three electric self-

driving shuttles to link a new bus rapid transit center to a retail district, connecting more residents to jobs. Columbus also plans to use data analytics to improve health care access in a neighborhood that currently has an infant mortality rate four times that of the national average, allowing them to provide improved transportation options to those most in need of prenatal care.

Public-private partnerships were essential to the success of the Smart City Challenge. The Department announced partnerships with some of the most innovative folks in the private sector, including launch partner Paul G. Allen's Vulcan Inc., cloud partner Amazon Web Services, NXP® Semiconductors, Mobileye, Autodesk, Alphabet's Sidewalk Labs, AT&T, DC Solar and Continental Automotive. In addition, these seven cities were able to leverage U.S. DOT's \$40 million grant to raise approximately \$500 million more in funding – a vast majority of which comes from a diverse group of over 150 partners. These partnerships illustrated the private-sector enthusiasm to help build an inclusive transportation system of the future.

**Paul G. Allen's Vulcan Inc.:**

"Climate change is a complex challenge, and it will take all of us working together to develop innovative, scalable solutions. One of this competition's greatest strengths is how it incentivized leaders across the public, private and nonprofit sectors to collaborate," said Paul G. Allen. "It is my hope that cities across the country will draw from and adapt the ideas from the Smart City Challenge to transform their transportation networks and help put their communities on a more sustainable path."

**Mobileye:**

"We were impressed with how well the finalists demonstrated their commitment to transforming their respective cities into a fully-integrated city of the future, especially where safety was concerned," said Mobileye Co-Founder, CTO and Chairman Professor Amnon Shashua. "We anticipate significant advancements from each finalist as a result of this challenge and hope they continue to embrace forward-looking solutions, like Mobileye, and transform transportation infrastructure and safety in their cities. We are more than ready to play our part in ushering in the nation's first truly smart city and look forward to working with the winner through our participation with Secretary Foxx and the DOT's Smart City Challenge"

**NXP Semiconductors:**

"At NXP, we are honored to be able to provide Columbus with innovations that will truly make a difference to how its citizens live and work," said NXP CEO and President Rick Clemmer. "Through vehicle-to-vehicle and vehicle-to-infrastructure (V2X) technology as well as RFID tagging and smart card ICs, NXP will help Columbus keep its roads safer, reduce pollution, and create more streamlined traffic and toll payments. We look forward to partnering with Columbus and to watch it become a real, tangible example of what the secure, smarter world will look like."

**Autodesk:**

"The public and private sectors are generally viewed as at odds with one another, but Transportation Secretary Anthony Foxx's Smart City Challenge proves that we can indeed work together to address the challenges facing our cities," said Carl Bass, CEO of Autodesk. "The Smart City Challenge offered the tech industry and city leaders a common platform to envision and plan a more intelligent, sustainable urban future. We applaud Transportation Secretary Anthony Foxx for his leadership in creating this collaborative effort."

**Alphabet's Sidewalk Labs:**

"The DOT Smart City Challenge has inspired cities to shift away from operating in traditional agency silos and towards

creating a coordinated, outcome-focused transportation system that reduces congestion and enhances transport equity," says Anand Babu, COO of Sidewalk Labs. "Data is the key to enabling this transformation, and Sidewalk Labs is excited to partner with cities to provide data-driven applications to better manage roads, parking, and mass transit, and to encourage shared mobility. When governments and technologists collaborate, there is an enormous potential to reimagine the way we approach urban mobility, and Secretary Foxx and the DOT should be commended for moving this critical conversation in a new direction."

**Amazon Web Services:**

"Amazon Web Services collaborated with the seven finalist cities during the challenge, and will work closely with Columbus to help implement their smart city vision. Cloud technology is enabling collaboration and the creation of citizen services at an unprecedented rate."

**AT&T:**

"AT&T congratulates Columbus on a job well done by showing the vision of what a smart city can accomplish for its citizens," said Mike Zeto, general manager and executive director, AT&T Smart Cities. "While we look forward to continuing to work with all 78 cities that entered the Challenge, AT&T is especially thrilled to help Columbus bring to life its winning smart cities vision by providing a framework for success that can be scaled across the region and other cities as well."

**DC Solar:**

"The Smart City Challenge is a visionary initiative and DC Solar is proud to be named a partner with the DOT," said Jeff Carpoff, DC Solar's CEO. "We look forward to working with the city of Columbus to provide solar energy access through mobile solar solutions and EV infrastructure. DC Solar is excited to work with all the finalist and applicant cities who seek clean energy solutions. We applaud Secretary Foxx's innovative leadership, and we believe the Smart City Challenge will become a model for encouraging clean technologies in communities throughout the U.S."

**Continental:**

"At Continental, safety is at the cornerstone of everything that we do. That is why we are proud to join the USDOT's national Smart City Challenge as a provider of active safety technology and secure connectivity to help advance the development of future mobility services such as automated driving infrastructure solutions, Intelligent Transportation Systems and V2X technology," said Samir Salman, CEO of Continental North America. "The Smart City Challenge aligns with our company's mission of Vision Zero, which is our goal to globally eliminate traffic and road fatalities, making mobility safer, more convenient and more efficient for everyone."

The Department of Transportation and its federal partners, including the Department of Homeland Security, the Department of Energy, and the National Institute for Standards and Technology, have committed to keep working collaboratively with all seven finalist cities to identify potential federal, state, local, and private resources to help carry out their Smart City plans. In addition, Vulcan Inc. has announced a new commitment to provide additional funding to support the climate and electrification efforts of all seven cities.

To learn more about the Smart City Challenge, visit [www.transportation.gov/smartcity](http://www.transportation.gov/smartcity).

###

**Appendix XXII. Press Release, Peloton, *Lockheed Martin Invests in Peloton Technology and Commercializing Truck Platooning* (Aug. 31, 2015).**

# Lockheed Martin Invests in Peloton Technology and Commercializing Truck Platooning | VentureBeat | Business

Business Wire August 31, 2015 2:02 AM

***Lockheed Martin joins seven other Fortune Global 500 companies investing in Peloton and commercializing truck automation***

MOUNTAIN VIEW, Calif.-(BUSINESS WIRE)-August 31, 2015-

**Peloton Technology**, a developer of vehicle systems that deliver advanced safety, fuel savings and analytics to trucking fleets, today announced an investment agreement with **Lockheed Martin** to accelerate Peloton's development and deployment of truck-platooning technology for the U.S. and international trucking industries.

"We are excited to be working with Lockheed Martin, a recognized leader in automated vehicles and safety-critical systems," said Peloton CEO **Josh Switkes**. "Lockheed Martin understands and supports our mission of increasing safety and fuel savings across the industry."

The Peloton Truck Platooning System is a vehicle automation technology that has the potential to save lives and save fuel in today's trucking operations. The System electronically couples pairs of trucks through a combination of vehicle-to-vehicle communications, radar-based active braking systems and proprietary vehicle-control algorithms. The system improves safety and allows trucks to travel at closer distances, which improves aerodynamics and reduces fuel use.

Lockheed Martin joins a \$17 million investment round co-led by **DENSO International America** and **Intel Capital**.

"Lockheed Martin is committed to partnering with Peloton and excited to be working with such a strong team of strategic investors," said Adam Miller, New Initiatives director for Lockheed Martin Missiles and Fire Control. "Our partnership is consistent with Lockheed Martin's approach of researching and investing in disruptive and cutting-edge technologies."

By partnering with Peloton Technology, Lockheed Martin joins an investment group that includes seven Fortune Global 500 companies in technology and transportation as well as several venture capital funds.

Lockheed Martin has been a leader in autonomous vehicles for more than three decades, from the pioneering Autonomous Land Vehicle to the cutting-edge Autonomous Mobility Applique System (AMAS), which aims to provide driver assistance and automation to military vehicles in convoys through a multiplatform kit of sensors and control systems.

In the Peloton Truck Platooning system, a direct communication link enables the rear truck to react automatically to acceleration or braking by the front truck nearly instantaneously, enabling more tightly spaced and fuel-efficient operation. Peloton's Cloud-based Network Operations Center continuously monitors individual truck safety and approves the linking of pairs of trucks only on suitable roads under appropriate weather, vehicle and traffic conditions. Drivers retain steering control and command of their vehicles at all times. The Peloton System integrates best-in-class active safety systems with cloud-based monitoring, making individual trucks safer at all



times and delivering a rapid return on investment to fleets via fuel efficiency.

In 2013, Peloton began demonstrating its Truck Platooning System with fleets and other transportation stakeholders in the U.S., where the trucking industry is worth \$700 billion annually.<sup>1</sup> The System is proven to reduce fuel consumption by 10% for the rear truck and 4.5% for the front truck, based on industry-standard SAE J1321 Type II fuel economy testing conducted by the North American Council for Freight Efficiency.

Peloton's executive team includes founders Switkes; Principal Scientist Dr. Chris Gerdes, Director of the Center for Automotive Research at Stanford; Chief Innovation officer Dave Lyons, former Tesla Director of Engineering, IDEO Studio Head and Silicon Valley tech veteran; and VP External Affairs/Business Development Steve Boyd, former White House Assistant Press Secretary, PBS reporter/producer and seasoned business development executive. As VP Cloud Engineering, Ex-Yahoo and Oracle executive Chuck Price leads a team that includes Valley innovators in digital mapping, data engineering and the web, including key engineers from eBay, Yahoo, Oracle, deCarta, Dash. The Peloton vehicle engineering team includes key engineers from the DARPA automated vehicle challenges, Google, the VW Electronics Research Laboratory, Stanford Center for Automotive Research and other automotive driver assistance, safety and vehicle control experts.

To date, the Peloton System has logged more than 15,000 platooning miles and been showcased in on-highway demonstrations, government, private and fleet tests in Nevada, Utah, Texas, Ohio, Florida, Alabama and Michigan. Demonstrations and fleet pilot deployments in additional states will be held later this year.

### About Peloton Technology

Peloton Technology is a Silicon Valley-based vehicle automation company that is bringing new levels of safety, efficiency and analytics to freight trucking. Peloton employs vehicle-to-vehicle communications, active safety systems, vehicle control algorithms, and real-time monitoring to make individual trucks safer and enable platooning by pairs of tractor-trailers. Peloton systems also provide rich contextual data solutions for fleets and other transportation sector customers. Backed by eight Fortune Global 500 transportation and technology companies and other investors, Peloton is bringing its solutions to the \$700 billion US trucking industry and international markets. Visit [www.peloton-tech.com](http://www.peloton-tech.com) and follow us on twitter @pelontech.

<sup>1</sup> (American Trucking Associations, 2014).

View source version on businesswire.com: <http://www.businesswire.com/news/home/20150831005306/en/>

Peloton Technology

Steve Boyd, 650-690-2035 or 202-441-0442

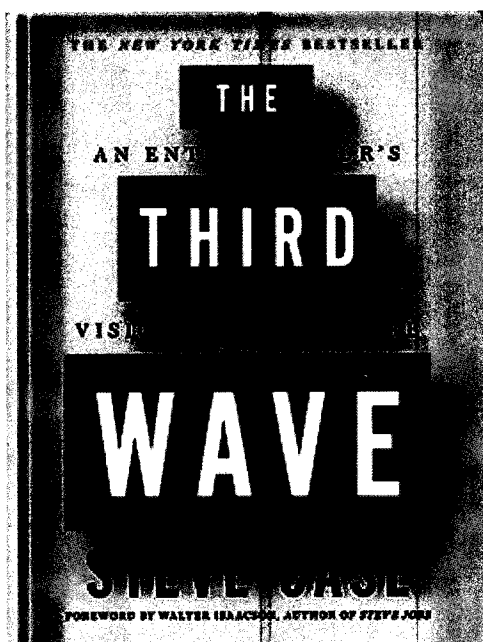
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## What Steve Case's 'third wave' means for global startups

*Image Credit: jamesteohart / Shutterstock*

As startups begin to tap into relatively untouched areas of the economy, legendary entrepreneur and cofounder of AOL, Steve Case, has released a book titled, [The Third Wave: An Entrepreneur's Vision of the Future](#). The book

describes the new era we are entering of immense technological advancements that are transforming virtually every non-digital sector of the economy, including education, healthcare, our food system, and beyond.



In his book, Case describes how the first wave laid the foundation for the online world — technology companies developed the hardware and software that made it possible for people to connect to the Internet. The second wave grew on top of that foundation. Search, social, and e-commerce startups made it easier for us to sort through the vast amount of information now available at our fingertips. Social networking and mobile applications also emerged and radically changed our everyday lives.

Now, he claims, we are entering the third wave, where ubiquitous connectivity will allow startups to transform major, real-world sectors of the economy. However to do so, Third Wave entrepreneurs will need to build partnerships and collaborate with governments and policy-makers in ways that the second wave has so far, hardly had to do.

## Startup-government collaborations

Governments have the ability to partner with startups to transform the way they are delivering services to their citizens across the globe, but these collaborations will require radical changes in mindsets and policy to be successful. Startups will need to engage with governments and navigate regulatory rules successfully to bring a product or service in these sectors of the economy to market.

Case also believes that revolutionary innovations in the Third Wave will come from various regions outside of Silicon Valley, and he touches on a few of the new startup hubs with developments underway across the United States, including the Midwest and the Big Easy, but what about the startup hubs forming outside of the U.S.? What are the implications of the third wave concept for startups globally?

While government-startup collaborations are still in the early stages globally, many countries are taking lessons from success stories in the U.S. and envisioning how they too could benefit from collaborating with startups to improve the lives of their citizens at a much faster rate.

## How the third wave will play out beyond the U.S.

In regions like Latin America, tech adoption is still behind the U.S. and investors tend to be much more conservative and risk-averse. We may see startups in emerging markets move directly from the first wave to the third wave, skipping the bulk of the second wave altogether.

Rather than taking the traditional routes to funding a new idea, which often can be painstakingly slower than the same approaches in the U.S., it's highly likely we'll see a growing number of startups in emerging markets focus instead on bringing their ideas to market by cooperating with governments and making strategic government partnerships. If innovators in these regions are to transform real-world sectors of the economy, the startups who identify with the importance of government cooperation will have a better chance at scaling and succeeding. Needless to say, this approach does not apply to all startups, but for those that it does, they should take advantage and move fast.

Marcelo Cabrol, manager of external communications for the Inter-American Development Bank Group, explains in his piece on the collaboration opportunities for startups and governments that it may be more promising for startups to create situations that drive governments to demand collaboration in order to adopt and to receive the innovative products or services startups have to offer. This approach also assumes that governments will embrace more risks than they're currently willing to accept. However, this type of collaboration could result in greater benefits for all.

Cabrol also points to the example of Colombia-based 1DOC3, a Spanish-language web platform in which physicians are available 24 hours a day to answer inquiries for free and anonymously, which has attracted many teenagers to the platform seeking guidance and answers to questions about contraception, teenage pregnancies, and more. According to a National Demographic and Health Survey, 19.5% of Colombian women between the ages of 15 and 19 years old are mothers or pregnant. The response to the platform has been incredible. 1DOC3 has delivered more than 14 million medical suggestions and has teamed up with the Colombian Institute of Family Welfare (ICBF) as part of a strategy to reduce teenage pregnancies in the country.

Mark Zuckerberg also praised the company during the recent Facebook F8 conference in San Francisco. Zuckerberg commended 1DOC3 as a prime example of how startups can create tools for the good of the people — precisely the type of partnership Case also envisions dominating the third wave.

As we move into this exciting new era, Case declares that “disruption can no longer be a mantra; it has to be a strategy. And while your product has to be great, your partnership skills may end up determining your success or failure.” I believe this will be particularly important for startups outside of the U.S. that may be tossing around disruptive ideas to change the lives of everyday people — whether it's in the healthcare, transportation, or agriculture sector of the economy. Entrepreneurs must find the best ways to work with governments and get governments to work with them if they are to survive and thrive the next wave.

*Gonzalo Costa is cofounder and managing partner at NXTP Labs, the most active early stage fund for tech companies in Latin America. He also provides consulting services related to management and strategy for venture creation and financing in emerging markets.*

**Appendix XXIII. Neil Abt, *Platoon Use to Begin in '16: Fleet to Implement System, Peloton CEO Says*, TRANSPORT TOPICS (Aug. 17, 2015).**

# Transport Topics

8/17/2015 4:00:00 AM

## Platoon Use to Begin in '16 (includes video)

### Fleet to Implement System, Peloton CEO Says

**This story appears in the Aug. 17 print edition of Transport Topics.**

Peloton Technology's platooning system will be introduced into a trucking fleet's operations for on-highway testing early next year.

"With this next step, we will show it really works in a fleet operation," CEO Josh Switkes said in an interview with Transport Topics.

"We know every fleet is different, but this first one will help show how effective it can be" in raising fuel economy and improving highway safety, Switkes said during a recent hourlong telephone interview from his office in Mountain View, California.

He predicted platoons — a convoy of two or more trucks linked electronically to a lead truck with an active driver in each — could be a fairly "common occurrence" within three years.

He would not disclose the fleet or where the testing would take place, other than saying "our system restricts platooning to interstates and major highways."

The tests will be limited to two-truck platoons, not only because it is technologically simpler than longer chains, but also because it helps alleviate worries regarding road users, including other truckers.

FinalCut V5



"We hear concerns we could create a blockade, making it harder to enter or exit a highway," Switkes said. "We are confident we can handle that by automatically separating the trucks when needed."

In the future, he said, automatic software updates are all that would be needed to move ahead to longer platoons.

Peloton has tested its platooning technology for about 15,000 miles, which Switkes classified as "way more than a typical research or demonstration project, but not yet a fully validated production system."

That included a test in Utah with C.R. England as well as projects with the U.S. Department of Energy and other groups in several additional states.

A report earlier this year by the American Transportation Research Institute on a "driver-assistive truck platooning" project said platooning can offer the trailing truck up to 10% fuel economy and up to 5% for the leading truck. The report on the Federal

Highway Administration-funding project that is led by Auburn University and includes Peloton, Peterbilt Trucks and Meritor Wabco, also said platooning could improve traffic flows if market penetration reached 60%.

It likely will be a while before platoons become that popular, but there are signs the technology is gaining momentum.

In late July, the company received an investment from Nokia Growth Partner. That announcement came on the heels of a \$16 million infusion led by Denso International America and Intel Capital, with funding from Volvo Group Venture Capital, UPS Strategic Enterprise Fund and others.

"We're working with, and getting good input from, all these companies but we don't have any commercial arrangements or exclusivity with the companies," Switkes said. "We plan to try to deploy our system eventually on all the OEMs and as many fleet customers as we can."

Also in July, Switkes participated in the Automated Vehicle Symposium in Michigan, where he was one of the few focused primarily on trucking rather than cars. He said there has been one notable difference in the few years this event has taken place.

"It used to be more academics and researchers talking about automation. Now it is people really talking about deployment and real products, he said.

Switkes, who earned a doctorate in mechanical engineering from Stanford University, is one of the founders of the company formally launched in 2013. His career includes developing production control systems for Volkswagen, Audi and Tula Technology.

Peloton, named after a bicycle-racing term for a group of riders who save energy by riding in close formation, employs about 25 people. Dave Lyons, the chief innovation officer, and principal scientist Chris Gerdes are among the other co-founders. Rodney Slater, a former U.S. transportation secretary, serves on the board of directors.

Platooning is centered on a radar-based collision-avoidance system, which is offered by several industry suppliers and truck makers.

Using vehicle-to-vehicle communications, Peloton connects vehicles' active braking and adaptive cruise control systems. While the drivers still steer (it is not designed to ever be fully autonomous) the system monitors road conditions and can recognize a need to brake before the lead driver becomes aware. The trailing truck is usually video-linked to the lead vehicle.

The braking of the rear vehicle happens almost instantaneously, Switkes said. That alleviates concerns about rear-end collisions despite the closer following distances that generate the fuel-economy benefits in the platoon.

Under ideal conditions, platooning trucks can travel as close as 36 feet from each other.

Especially for the trailing truck, "we can react much more quickly than a human . . . and even much more quickly than a radar sensor because we have this direct knowledge of the brake application in the front truck. And we know how much it has applied its brakes," he said.

If the back truck applies the brakes, the trucks will automatically delink. The platooning distance can also be automatically changed if a car attempts to cut between the platoon.

This happens through the company's completely automated "platooning network operations center." Switkes said the company's system also allows it to automatically restrict platoons when the situation arises and adjust following distances remotely based on road or weather conditions.

Initially, the most likely platooning scenario involves one fleet sending out two trucks from the same facility. They could platoon along much of the route before separating for their final destinations.

However, Switkes said the company's operations center can help locate platooning partners from different fleets or owner-operators. In that scenario, a driver would be automatically notified, and, if accepted, would be provided instructions on the need to slow down or speed up to automatically make an electronic connection of the trucks happen.

Switkes acknowledged that some carriers could be leery — or simply refuse — to platoon with others they view as competitors, but he believes the more they learn about the fuel savings and safety benefits of the system, those concerns likely will subside.

Switkes said the vehicle-to-vehicle communications gives Peloton access to performance and load information that enhances safety. For example, the system would have data about the type and condition of brakes of each vehicle and order them with best brakes in the back.

Likewise, he said truckers will take to the platooning concept, one he believes can make the job a "bit less stressful."

"Let's not throw out that experience and that skill, but let's give drivers the tools to do their jobs better," he said. "Humans are limited in reaction time — we can address that in vehicle-to-vehicle communications."

Switkes said platooning generally has been well-received among a number of states, including Utah, California, Florida and Iowa. Several have gone so far as to clarify existing tailgating laws to ensure testing can successfully be undertaken.

Continuing to educate the public also needs to take place.

7/10/2016

Platoon Use to Begin in '16 (includes video) | Transport Topics Online | Trucking, Freight Transportation and Logistics News

"As an industry, we have to really put it out there for the public, he said. "Here is the benefit — now let us prove it to you so you accept it."

Switkes said that process may be easier for platooning than autonomous-driving trucks, similar to what Daimler AG showed in Nevada this past May.

"There is a lot more attention on truck automation than there was before," he said, "and that is good for the whole industry."

*By Neil Abt*

*Editorial Director*

**Appendix XXIV. Michele Segata et al., *Emergency Braking: A Study of Network and Application Performance* (Nov. 30, 2011).**



## **Motivation**

- The **interaction** of the **communications (protocols)** with the car's **adaptive cruise control (ACC) system** and the driver's behavior for cars that are not equipped with these communication devices.
- Considering Collisions and combining driver's behavior instead of crash-free
- Just a **simulation** study (ns-3) on Emergency Electronic Brake Lights (**EEBL**)

## **Emergency Braking: A Study of Network and Application Performance**

--Michele Segata, Renato Lo Cigno, VANET, 2011.

**Renyong Wu**

2011.11.30

### 3. Simulation Models and Tools

Introduce a **maximum deceleration** (10m/s) as a physical limit in addition to the value obtained from the IDM formula:

$$a(t) = \max(-b_1^{\text{max}}, a^{\text{IDM}}(t))$$

### 1. Introduction

#### Questions:

- How do EEBL and the VANET network actually interact?
- What is the market penetration rate that makes EEBL benefits measurable?
- Do non-equipped vehicles benefit from a partial EEBL introduction?
- What is the most effective communication range?
- Are rebroadcast techniques needed to make EEBL more effective? If yes, how do they impact the network load?
- Can we find easy and efficient message aggregation techniques?